METHOD AND SYSTEM FOR ENCODING AND FAST-CONVERGENT SOLVING GENERAL CONSTRAINED SYSTEMS

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the benefit of provisional patent application no. 60/420,920, filed October 23, 2002.

TECHNICAL FIELD

The present invention relates to optimization methodologies and, in particular, to a method and system for encoding a class of constrained optimization problems, and then employing a generic, meta-level, iterative optimization technique to solve the encoded class of constrained optimization problems.

BACKGROUND OF THE INVENTION

It is well known that scheduling of scarce nonrenewable resources subjected to constraints is an NP-hard problem. Suppose that there is a set of tasks W and there is a set of N resources that can be assigned to tasks w e W. The problem that needs to be addressed is to schedule the N resources among the W tasks in an optimal or near optimal manner. Assume $u_w^i(t)$ to be a piecewise constant function of the assignment of resources i to task w. Assume $d^w(t)$ to be a piecewise constant function of the demand for resources for task w. Then the optimization problem is as follows:

$$\min_{u_w^1(t),\ldots,u_w^N(t)} \sum_{w \in W} \int_0^T c_w(t) \left| d^w(t) - \sum_{i=1}^{N} u_w^i(t) \right| dt$$

where $c_w(t)$ is a time-varying cost of not satisfying demand for task w.

SUMMARY OF THE INVENTION

The present invention provides a method and system that produces a near-optimum schedule in linear time by providing an optimal resource ordering scheme.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is embodied in a computer program that, using a state vector definition and a defined cost-go-go function, optimally orders resources for scheduling.

Define a state vector $x_w^k(t)$ as follows:

$$\begin{aligned} &x_w^{k+1}(t) = x_w^k(t) + u_w^k(t), \\ &x_w^1(t) = 0, \\ &x_w^2(t) = u_w^l(t), \\ &w \in W \end{aligned}$$

The optimization problem described above then becomes:

$$\min_{u_w^l(t),\dots,u_w^N(t)} \phi(x_w^N(t))$$

subject to the above definition for $x_w^k(t)$ where

$$\phi(x_w^N(t)) := \sum_{w \in W} \int_0^T c_w(t) \left| d^w(t) - x_w^N(t) \right| dt$$

Define a cost-to-go function $V(x_w^N(t), k)$

$$V(x_w^N(t), k) := \min_{u_w^l(t),\dots,u_w^N(t)} \left\{ \phi(x_w^N(t)) \right\}$$

$$x_w^N(t) = y(t)$$

Then by Bellman's principle of optimality,

$$V(y, k) := \min_{u_w^k} \left\{ V(y(t) + u_w^k(t)), k+1 \right\}$$

$$x_w^N(t) = y(t)$$

$$V(x_w^N(t), N) := \phi(x_w^N(t))$$

Optimal ordering of resources is based on the following weighting function:

$$\zeta_1 f_1^i + \zeta_2 f_2^i$$

where ζ_1 and ζ_2 are relative weight coefficients, f_1^i is a variable that defines how a user values resource i, and f_2^i is a variable that defines an actual cost of resource i.

The resources are arranged based on the respective values of the weighting function in such a way that the resources with the smallest values go first.